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To the communication of August 10, 2000

1. The applicant herewith presents a set of claims 1 to 41 of which claims 1 to 3 are amended as to their content with respect to the claims presently on file, whereas claims 4 to 34 correspond to the claims on file apart from newly introduced (additional) reference numerals and claims 35 to 41 correspond to claims 36 to 42 on file, new reference numerals inserted, too. Inasfar terms as "slightly" a.s.o. were previously contained in these claims and have been objected to (section 2 of the official communication) such terms have been deleted. Claim 35 on file has been deleted being superfluous in view of claim 29.

Anderer Wortlaut als später erteilt! vgl. A & K 1a!

1.1 The applicant is grateful for the examiner's hint to the features stated in the description bridging pages 32 and 33, and now makes use of part of same as a basis of disclosure for the definition in para.3 of new claim 1. That is, in the related text there is disclosed that in the distant vision position the lens arches rearwardly and forwardly ("beyond the intermediate position of Fig.7") in the near vision position. Figs. 5 to 8 clearly show these positions for the lens embodiment being flat in the unstressed state and Figs. 48 to 50 (related text on page 67, lines 21 to 23) for the lens embodiment having an anteriorly offset optic in the normal state. The applicant trusts that these parts of the description and drawings are a sufficient disclosure

support for the definition in new claim 1 stating that the optic of the lens lies posterior and anterior, respectively, of the outer ends of the haptics.

1.2 The reference to "forces imparted through constriction and relaxation of the ciliary muscle" in new claim 1 is to be considered not a feature of the human body being inadmissible in a claim but an admissible explanation and characterisation of the type of forces which generate the rearward and forward arching of the lens such that the optic is positioned rearward and forward, respectively, with respect to the outer ends of the haptics.

1.3 For the disclosure of claims 2 and 3 reference is made to page 9, first para. and to page 27, first para., respectively.

2. New claim 1 now defines the invention in a distinct manner and as the result of an inventive step over document D2 which teaches a lens forming a substantially continuous (forwardly) arched surface. The forward vault of the lens of D2, the placement thereof in front of the iris and the required planar rear face of the optic (to be clear of the iris) teach away from the present invention which extends the anterior and posterior deflections of the lens to forward and rearward arching, respectively, thereby allowing for better utilizing the force of the ciliary muscle in combination with the support from the posterior capsule of the capsular bag (see page 33, lines 9 et seq.).

The teaching of document D1 is basically different from the present invention inasfar the haptics 70,72 and 74 of the embodiment of Fig.2 move the optic 50 back and forth along an axis X (col.4, l.5) **which is not the optical axis Z** of the eye but is perpendicular to the optical (or center) axis Z. Thus the optic is not moved anteriorly and posteriorly, in the sense of the invention and also of D2, but sideways in order to place different regions of the lens in the rays path (see col.3, l. 60 et seq.). The same holds true in regard to the embodiment of Figs. 5 and 6 in which two progressive power lenses 200 and 202 are placed one behind the other in a partial overlapping relationship. These lenses are also moved sideways but in opposite directions along said X-axis (col.7, l.49).

It is true, there is a further embodiment described in D1 wherein haptics supporting an optic within the sulcus of the ciliary muscle move the optic anteriorly and posteriorly within the meaning of the present invention, i.e. along the optical axis Z of the eye. However this embodiment of Figs. 3 and 4 has an optic composed of two lenses 100 and 102 placed one

behind the other which are to move toward and away from one another (col.5, l. 56,57). This cannot be an incentive for the present invention because in this way D1 relies on an arching of the individual lenses in one direction only not in opposite directions as the invention does. Also looking upon D1 and D2 in common cannot render obvious the subject of claim 1 because the lens of D2, on account of its intentional arching, is impractical for the double lens structure of D1, and the individual lenses of D1 even emphasize the elastic deflection in one direction only. Moreover, the double lens optic of D1 means a very complicated structure, and the forces of the ciliary muscle have to deform the haptics of two lenses not of only one and thus the haptics will have to be designed very delicately.

3. The replacement pages 3, 7 and 8 presented together with applicant's letter of January 12, 2000 appear not to require a supplement in view of new claim 1. However if the examiner deems any amendment or supplement necessary, applicant respectfully asks for an according advice.

3.1 As the embodiments according to Figs. 13, 14 and 15 do no longer fall under the scope of new claim 1, replacement pages 19 and 20 are enclosed herewith which state this fact explicitely.

The applicant now looks forward to a favourable further Official Action.

For the applicant by:

(Lohrentz)

Brief Description of Drawings

Figure 1 is a section through a human eye from which the natural lens matrix has been removed by a surgical procedure involving anterior capsulotomy, such as capsulorhexis, of the natural lens, and illustrating an accommodating simple plate haptic accommodating lens according to this invention implanted within the capsular bag of the eye.

Figure 1A is a section through a normal human eye.

Figure 2 is an anterior side view of the intraocular lens of Figure 1.

Figure 3 is a section taken on line 3-3 in Figure 2.

Figure 4 is a section taken on line 4-4 in Figure 1.

Figures 5-8 illustrate the manner in which the intraocular lens of Figures 1-4 is utilized in the eye of Figure 1 to provide accommodation.

Figures 9-12 are sections, similar to Figure 3, through modified accommodating intraocular lenses according to the invention having alternative optical shapes.

Figures 13,14 are sections similar to Figure 3 illustrating normal and deflected positions, respectively, of an intraocular lens not falling under the scope of claim 1.

Figure 15 is a section through an accommodating intraocular lens not falling under the scope of protection of claim 1.

Figure 16 is an anterior side view of a modified accommodating intraocular lens according to the invention having integral fixation means for fixing the lens in the capsular bag of the eye.

Figure 17 is a section taken on line 17-17 in Figure 16.

Figures 18-21 are anterior side views of modified accommodating intraocular lenses according to the invention having alternative integral fixation means for fixing the lenses in the capsular bag of the eye.

Figure 22 is an anterior side view of a modified accommodating intraocular lens according to the invention having springs for aiding accommodation.

Figure 23 illustrates the lens of Figure 22 implanted within the capsular bag of a human eye like that in Figure 1, and showing the lens in the position which the lens occupies immediately after surgery as well as after a certain degree of accommodation.

Figure 24 is a view similar to Figure 23 showing the lens in its posterior distant vision position.

Figures 25-30 are anterior side views of modified

Claims

1. An accommodating intraocular lens to be implanted in a human eye within a natural capsular bag in the eye attached about its perimeter to the ciliary muscle of the eye, the lens comprising:

a lens body having normally anterior and posterior sides and including an optic (34,56,68,78) and haptics (36,52,60,73,84) extending from opposite sides of said optic and having inner ends adjacent said optic and opposite outer ends, and wherein

said lens body is adapted to move the optic (34,56,68,78) anteriorly and posteriorly relative to the outer ends of said haptics (36,52,60,73,84) in response to forces imparted through constriction and relaxation of the ciliary muscle (28) of the eye, wherein relaxation of the ciliary muscle effects posterior deflection of the lens such that the optic lies posterior to the outer ends of said haptics and constriction of the ciliary muscle effects anterior deflection of the lens such that the optic lies anterior to the outer ends of said haptics.

2. An accommodating intraocular lens according to Claim 1, wherein:

said haptics have a hinge (38,58,74,88,158) between their respective inner and outer ends about which the haptics and optic flex in response to forces imparted through contraction and expansion of the natural capsular bag (20) of the eye.

3. An accommodating intraocular lens according to Claim 2, wherein:

said haptic outer ends are disposed substantially in a common plane transverse to the optical axis of said optic, and wherein

said hinges (38,58,74,88,158) are configured to define flexible zones about which said haptics and optic flex, whereby the optic moves anteriorly and/or posteriorly along the optical axis in response to forces imparted through contraction and expansion of the natural capsular bag of the eye.

4. An accommodating intraocular lens according to Claim 3, wherein:

said lens body contains grooves (40,320) in at least one of said body sides along the inner ends of said haptics (36,312,320) forming flexible, reduced thickness portions of the lens body which constitute said hinges.

5. An accommodating intraocular lens according to Claim 1, wherein:

said haptics (52) are flexible throughout their length in said anterior and posterior directions relative to said optic.

6. An accommodating intraocular lens according to any of Claims 2 to 5, wherein:

said lens body is constructed of a material having an elastic memory, and said body an unstressed configuration in which said haptics (36), optic (34) and hinges (38) are disposed substantially in a common plane.

7. An accommodating intraocular lens according to any of Claims 1 to 5, wherein:

said lens body (54) is constructed of a material having an elastic memory, and said body has a normal unstressed anteriorly vaulted configuration in which said haptics (60) extend posteriorly relative to said optic (56).

8. An accommodating intraocular lens according to any of Claims 1 to 5, wherein:

said lens body (76) is contructed of a material having an elastic memory, and said body has a normal unstressed posteriorly vaulted configuration in which said haptics (84) extend anteriorly relative to said optic (78).

9. An accommodating intraocular lens according to any of Claims 1 to 8, wherein:

said optic (78) is offset posteriorly relative to the inner ends of said haptics (84).

10. An accommodating intraocular lens according to any of Claims 1 to 8, wherein:

said optic (904) is offset anteriorly relative to the inner ends (914) of said haptics (906).

11. An accommodating intraocular lens according to any of Claims 1 to 10, including:

springs (154) attached to the anterior sides of said haptics (156) adjacent said optic and extending along the haptics toward their outer ends, and wherein

said springs are resiliently biased toward the haptics and are determined to be engageable over the iris (18) of the eye to aid accommodation.

12. An accommodating intraocular lens according to any of claims 1 to 11 including fixation means (114,118,126,130,134) on said haptics for positioning and fixing the lens in said capsular bag of the eye.

13. An accommodating intraocular lens according to Claim 12, wherein:

said fixation means comprise projections (114,118) on the outer ends of said haptics.

14. An accommodating intraocular lens according to Claim 12, wherein:

said fixation means comprise openings (126,130) at the outer ends of said haptics.

15. An accommodating intraocular lens according to Claim 12, wherein:

said fixation means comprise loops (134,164,186) at the outer ends of said haptics.

16. An accommodating intraocular lens according to Claim 15, wherein:

said loops comprise spring loops (134).

17. An accommodating intraocular lens according to Claim 12, wherein:

said fixation means comprise separate fixation elements (164,186,200,224) slidable within longitudinal sockets (170,190,202,236) entering the outer ends of said haptics, and

said intraocular lens and fixation elements are separable.

18. An accommodating intraocular lens according to Claim 17, wherein:

said fixation elements comprise generally U-shaped loops (164,186) having legs (168,188) slidable in said sockets.

19. An accommodating intraocular lens according to Claim 17, wherein:

said fixation elements comprise generally cruciform-shaped members (224) having journals at one end slidable in sockets (236) in said haptics and cross arms (242) at the other end.

20. An accommodating intraocular lens according to any of Claims 17 to 19, wherein:

said fixation elements include means (174,240) for receiving a removable suture (176) for securing said lens body and fixation elements in assembled relation during implantation of the intraocular lens in the eye.

21. An accommodating intraocular lens according to Claim 12, wherein:

said fixation means comprise curved resilient spring arms (274,278) extending from the haptics.

22. An accommodating intraocular lens according to Claim 12, wherein:

said fixation means comprise springs (424,602,702,802) at the outer ends of said haptics having normal unstressed positions wherein said springs extend beyond their adjacent outer haptic ends in the endwise directions of the haptics and

are determined for resilient engagement with the perimeter of said capsular bag (20) of the eye.

23. An accommodating intraocular lens according to Claim 22, wherein:

said springs comprise spring loops (424,602,702,802).

24. An accommodating intraocular lens according to Claim 22, wherein:

said springs comprise spring arms (702,802) having base ends fixed to said haptics and opposite free ends, and each spring arm curves outwardly from the outer end of its respective haptic (706,806) in the endwise direction of the haptic and laterally of the haptic from its base end to its free end.

25. An accommodating intraocular lens according to Claim 22, wherein:

said springs comprise a single spring arm (424,602) on the outer end of each haptic having a base end fixed to the respective haptic (428,604) adjacent one longitudinal edge of the haptic and an opposite free end,

and each spring arm curves outwardly from the outer end of its respective haptic in the endwise direction of the haptic and laterally of the haptic from its base end to its free end.

26. An accommodating intraocular lens acording to Claim 22, wherein:

said springs comprise a pair of spring arms (702) on the outer end of each haptic having a common base end (704) fixed to the respective haptic (706) along the longitudinal centerline of the haptic and opposite free ends, and the spring arms on each haptic curve outwardly from the outer end of the respective haptic in the endwise direction of the haptic and laterally toward opposite longitudinal edges of the haptic from their common base end to their free ends.

27. An accommodating intraocular lens according to Claim 22, wherein:

said springs comprise a pair of spring arms (802) on the outer end of each haptic (806) having base ends (804) fixed to the respective haptic adjacent the longitudinal edges, respectively, of the haptic and opposite free ends, and

the spring arms on each haptic curve outwardly from the outer end of the respective haptic in the endwise direction of the haptic and toward one another laterally of the haptic from their base ends to their free ends.

28. An accommodating intraocular lens according to Claim 22, wherein:

said springs and the adjacent outer haptic ends form intervening openings (432).

29. An accommodating intraocular lens defined in any of Claims 1 to 28, in which said optic (34,68,78) has a convex posterior surface (72,82).

30. An accommodating intraocular lens defined in any of Claims 1 to 28, in which said optic (68) has Fresnel lens elements (70) formed thereon.

31. An accommodating intraocular lens defined in any of Claims 1 to 30, in which each of said haptic members (36,144,156,166) is tapered as to width and thickness.

32. An accommodating intraocular lens defined in any of Claims 1 to 31, in which said haptic members (36,144,156,166) are formed of a soft material.

33. An accommodating intraocular lens defined in Claim 29, in which the entire posterior surface (82,86) of the intraocular lens including the haptic members (84) has one continuous radius.

34. An accommodating intraocular lens defined in any of Claims 1 to 33, in which the intraocular lens is formed of a resilient material, and said optic is recessed posteriorly to allow

greater facility for anterior displacement during accommodation.

35. An accommodating intraocular lens according to any of claims 1 to 34, comprising: a round optic (228, 904) and plate haptics (226, 906) having inner ends (914) joined to diametrically opposite edge portions of said optic at junctions (230,908) between said optic and said haptics and opposite outer ends, and wherein the width of said junctions measured transverse to the length of said lens is substantially less than the diameter of said optic, whereby said optic has free edge portions of substantial circumferential length between said junctions, and

the circumferential length of each free edge portion substantially exceeds the width of each junction.

36. An accommodating intraocular lens according to Claim 35, wherein:

said haptics have outer end portions (910) which are relatively wide compared to the width of said junctions (908) and contain openings (918) adjacent the outer ends of the haptics.

37. An accommodating intraocular lens according to Claim 36, wherein bridge portions (920) extend across the outer ends of the haptics along and close the adjacent sides of said haptic openings (918).

38. An accommodating intraocular lens according to any of Claims 35 to 37 wherein:

said junctions (908) are hinge junctions about which said haptics are pivotally movable anteriorly and posteriorly relative to said optic and which constitute virtually the entire length of said inner end portions.

39. An accommodating intraocular lens according to any of Claims 35 to 38, wherein:

said optic (904) and haptics (906) have normally anterior and posterior surfaces,

said junctions (908) are flexible hinge junctions formed by grooves (916) in the anterior surfaces of said haptics immediately adjacent said optic edge portions and transverse to the length of the haptics, and said hinge junctions comprise flexible hinge portions joining said optic edge portions and said inner haptic ends, and said optic (904) is offset anteriorly relative to said haptics in such a way that said anterior optic surface projects forwardly of said anterior haptic surfaces, and said both haptic edge portions and said flexible hinge portions are situated within the thickness of said haptics and between said haptic surfaces.

40. An accommodating intraocular lens according to Claim 35, wherein:

said optic (904a) and haptics (906a) have normally anterior and posterior surfaces,

said junctions (908a) are flexible hinge junctions comprising flexible hinge portions joining said optic edge portions and said inner haptic ends, and

said optic is offset anteriorly relative to said haptics in such a way that said anterior optic surface projects forwardly of said anterior haptic surfaces, and said both haptic edge portions and said flexible hinge portions are situated forwardly of said anterior haptic surfaces.

41. An accommodating intraocular lens according to any of Claims 1 to 40 including:

projection means (286) extending anteriorly from the haptics (280) and determined to space the capsulorhexis from the optic.